UNIVERSITI SAINS MALAYSIA

First Semester Examination
2011/2012 Academic Session

January 2012

ESA 366/3 – Flight Performance
[Prestasi Penerbangan]

Duration : 3 hours
[Masa : 3 jam]

ARAHAN KEPADA CALON

Please ensure that this paper contains **SEVEN (7)** printed pages and **FOUR (4)** questions before you begin examination.
*Sila pastikan bahawa kertas soalan ini mengandungi **TUJUH (7)** mukasurat bercetak dan **EMPAT (4)** soalan sebelum anda memulakan peperiksaan.*

Instructions : Answer **ALL** questions.
Arahan : *Jawab **SEMUA** soalan.*

Student may answer the questions either in English or Bahasa Malaysia.
Pelajar boleh menjawab soalan dalam Bahasa Inggeris atau Bahasa Malaysia.

Each question must begin from a new page.
Setiap soalan mestilah dimulakan pada mukasurat yang baru.

In the event of any discrepancies, the English version shall be used.
Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah diguna pakai.

Answer **ALL** questions.
*Jawab **SEMUA** soalan.*

1. [a] Explain the construction of the standard atmosphere. Compare the equations for variations of p and ρ versus geopotential altitude for:

Terangkan pembinaan atmosfera piawai. Bandingkan persamaan untuk variasi p dan ρ berbanding ketinggian untuk:

[i] The isothermal layers and

Lapisan sesuhu dan

[ii] The gradient layers.

Kecerunan lapis.

(10 marks/*markah*)

[b] The General Electric J79 turbojet produces a thrust of 10,000 lb at sea level. The inlet diameter is 3.19 ft. If an airplane equipped with the J79 is flying at standard sea level with a velocity of 1,000 ft/s, calculate:

Turbojet General Electric J79 menghasilkan teras 10,000 lb di paras laut. Garis pusat masukan adalah 3.19 ft. Jika sebuah pesawat terbang yang dilengkapi dengan J79 terbang pada aras laut dengan kelajuan 1,000 ft/s, kirakan:

[i] The jet velocity relative to the airplane and

Jet halaju relatif kepada kapal terbang dan

[ii] The propulsive efficiency.

Kecekapan dorongan

(5 marks/*markah*)

[c] Derive the equations of motion of an aircraft in climbing flight.

Terbitkan persamaan gerakan pesawat dalam penerbangan mendaki .

(10 marks/*markah*)

Questions 2 – 3 : Refer to the following type of aircraft:
Soalan 2- 3 : Sila rujuk pada jenis kapal terbang berikut :

A light, single-engine, propeller-driven, private airplane, approximately modeled after the Cessna Skylane. We will designate this hypothetical airplane as the CP-1, having the following characteristics:

Kapal terbang dengan enjin tunggal yang ringan yang dipacu kipas, dimodelkan berdasarkan Cessna Skylane. Kapal terbang hipotesis ini dinamakan sebagai CP-1 dan mempunyai ciri-ciri berikut:

[i] Wingspan: 35.8 ft

Bidang sayap: 35.8 ft

[ii] Wing area: 174 ft^2

Keluasan sayap: 174 ft^2

[iii] Normal gross weight: 2950 lb

Berat kasar normal: 2950 lb

[iv] Normal capacity: 65 gallons of aviation gasoline

Keupayaan muatan minyak: 65 gallon gasolin

[v] Power Plant: One piston engine of 230 hp at sea level

Enjin: Enjin piston 230 hp pada aras laut

[vi] Specific fuel consumption: 0.45 lb/(hp)(h)

Spesifik pengunaan minyak: 0.45 lb/(hp)(h)

[vii] Parasite drag coefficient: $C_{D,0} = 0.025$

Pekali seretan parasit: $C_{D,0} = 0.025$

[viii] Propeller efficiency: 0.8

Kecekapan propeller: 0.8

2. For the CP-1 at sea level, $\rho_\infty = 2.377x10^{-3}$ slug/ft^3

Untuk pesawat CP-1 di paras laut, diberi $\rho_\infty = 2.377x10^{-3}$ slug/ft^3

[a] calculate and plot the thrust required curve.

kira dan plotkan lengkungan tujah yand diperlukan.

[b] calculate the power required curves.

kira lengkungan kuasa yand diperlukan.

[c] calculate the maximum velocity.

kira halaju maksimum.

[d] calculate the rate of climb versus velocity.

kira kadar pendakian berbanding halaju

(25 marks/*markah*)

3. The maximum lift-to-drag ratio for the CP-1 is 13.6.

Nisbah daya angkat-seret maksimum untuk CP-1 diberi 13.6.

[a] Calculate the minimum glide angle and the maximum range measured along the ground covered by the CP-1 in a power-off glide that starts at an altitude of 10,000 ft.

Kira sudut meluncur minimum dan julat jarak maksimum yang diukur sepanjang jarak yang diliputi oleh CP-1 dalam meluncur tanpa kuasa bermula pada aras ketinggian 10,000 ft.

(10 marks/*markah*)

[b] Calculate the equilibrium glide velocities at altitudes of 10,000 and 2000 ft, each corresponding to the minimum glide angle. Given $\rho_\infty = 0.0017556$ slug/ft^3 at 10,000 ft and at 2000 ft, $\rho_\infty = 0.0022409$ slug/ft^3.

Kira keseimbangan meluncur pada ketinggian 10,000 dan 2000 ft, masing-masing sepadan dengan sudut meluncur minimum. Diberi $\rho_\infty = 0.0017556$ slug/ft^3 pada aras 10,000 ft dan pada aras 2000 ft, $\rho_\infty = 0.0022409$ slug/ft^3.

(15 marks/*markah*)

Questions 4 : Refer to the following type of aircraft:
Soalan 4 : Sila rujuk pada jenis kapal terbang berikut :

A jet-powered executive aircraft, approximately modeled after the Cessna Citation 3. For convenience, we will designate our hypothetical jet as the CJ-1, having the following characteristics:

Sebuah pesawat eksekutif berkuasa jet, dimodelkan selepas Cessna Citation 3. Kapal terbang hipotesis ini dinamakan sebagai CJ-1 dan mempunyai ciri-ciri berikut:

[i] Wingspan: 53.3 ft

Bidang sayap: 53.3 ft

[ii] Wing Area: 318 ft^2

Keluasan sayap: 318 ft^2

[iii] Normal gross weight: 19,815 lb

Berat kasar normal: 19,815 lb

[iv] Fuel capacity: 1119 gallons of kerosene

Keupayaan muatan minyak: 1119 gallon minyak kerosin

[v] Power plant: two turbofan engines of 3650 lb of thrust each at sea level

Enjin: dua enjin turbofan berteras 3650 lb masing-masing.

[vi] Specific fuel consumption: 0.6 lb of fuel/ (lb thrust)(h)

Specifik pengunaan minyak: 0.6 lb of fuel/ (lb thrust)(h)

[vii] Parasite drag coefficient: $C_{D,0} = 0.02$

Pekali seretan parasit: $C_{D,0} = 0.02$

4. Estimate the lift-off distance for the CJ-1 at sea level. Assume a paved runway, hence $\mu_r = 0.02$. Also, during the ground roll, the angle of attack of the airplane is restricted by the requirement that the tail not drag the ground, and therefore assume that $C_{L,max}$ during the ground roll is limited to 1.0. Also, when the airplane is on the ground, the wings are 6 ft above the ground. For the CJ-1 at sea level, $\rho_\infty = 2.377 \times 10^{-3}$ slug/ft^3.

Anggarkan jarak berlepas pesawat CJ-1 pada aras laut. Anggapkan landasan berturap dan $\mu_r = 0.02$. Juga semasa pergerakan dibumi, sudut serangan pesawat tersebut diterhadkan oleh keperluan ekor tidak seret atas tanah dan oleh itu, dianggapkan $C_{L,max} = 1.0$ semasa pelepasan. Juga, semasa pesawat itu diatas tanah, sayap adalah 6 ft diatas tanah. Untuk CJ-1 pada aras laut, diberi $\rho_\infty = 2.377 \times 10^{-3}$ slug/ft^3.

(25 marks/*markah*)

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